The Altona Cover will provide residents living along the A7 with significant relief from highway noise from 2028. At the same time, new green spaces such as allotments, flowering meadows, and parks will be created on the roof of the noise protection cover.
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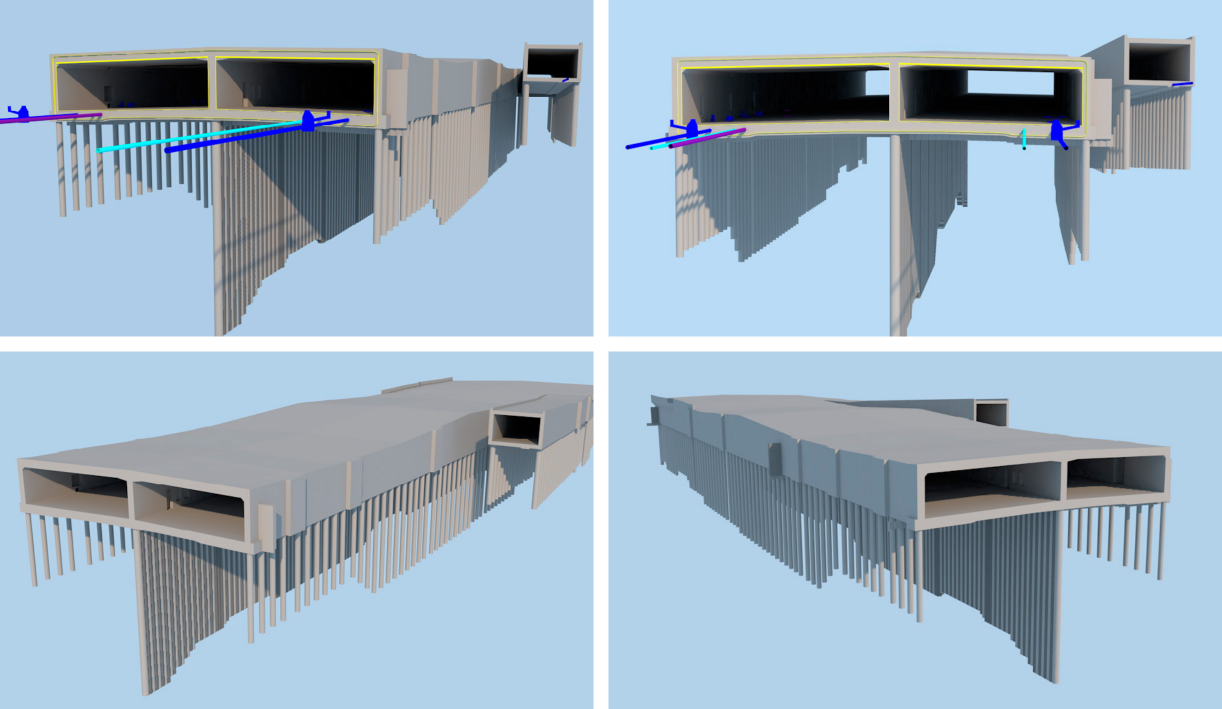
Allplan in Practice

THE ALTONA COVER: THE INTERSECTION OF BRIDGE AND TUNNEL DESIGN

Not a bridge, but a tunnel: HOCHTIEF Engineering innovatively employs parametric modeling in Allplan Bridge for the design of a tunnel section of the Altona Cover project.

With a traffic volume of more than 150,000 vehicles per day, the A7 north of the Elbe Tunnel in Hamburg city has long been one of the busiest roads in Germany. Therefore, as early as 2007, it was decided to expand the highway section from ten to twelve lanes. However, since traffic congestion affects not only those who travel on it but also – and above all – local residents, noise protection will also be significantly improved as part of the widening project. To this end, the A7 in Hamburg will receive three new noise protection covers by 2028 – in Schnelsen, Stellingen, and Altona. At the same time, this will reclaim the area previously severed by the open carriageways, providing green space in the form of allotments, flower meadows, and parks for the city, and creating a green link between the separated districts. In this groundbreaking infrastructure project, the approximately 2,230-meter-long Altona noise protection cover – the final stage – is the crowning glory, so to speak. A consortium comprising HOCHTIEF Infrastructure GmbH and Implenia is responsible for its design and



The high groundwater table in the area between the Elbe Tunnel and the S-Bahn Bridge necessitates a closed tunnel with combined pile slab foundations.
© HOCHTIEF Engineering

construction. A planning consortium consisting of HOCHTIEF Engineering GmbH and KREBS+KIEFER Ingenieure GmbH is mainly responsible for the approval and execution planning (phases 4 and 5).

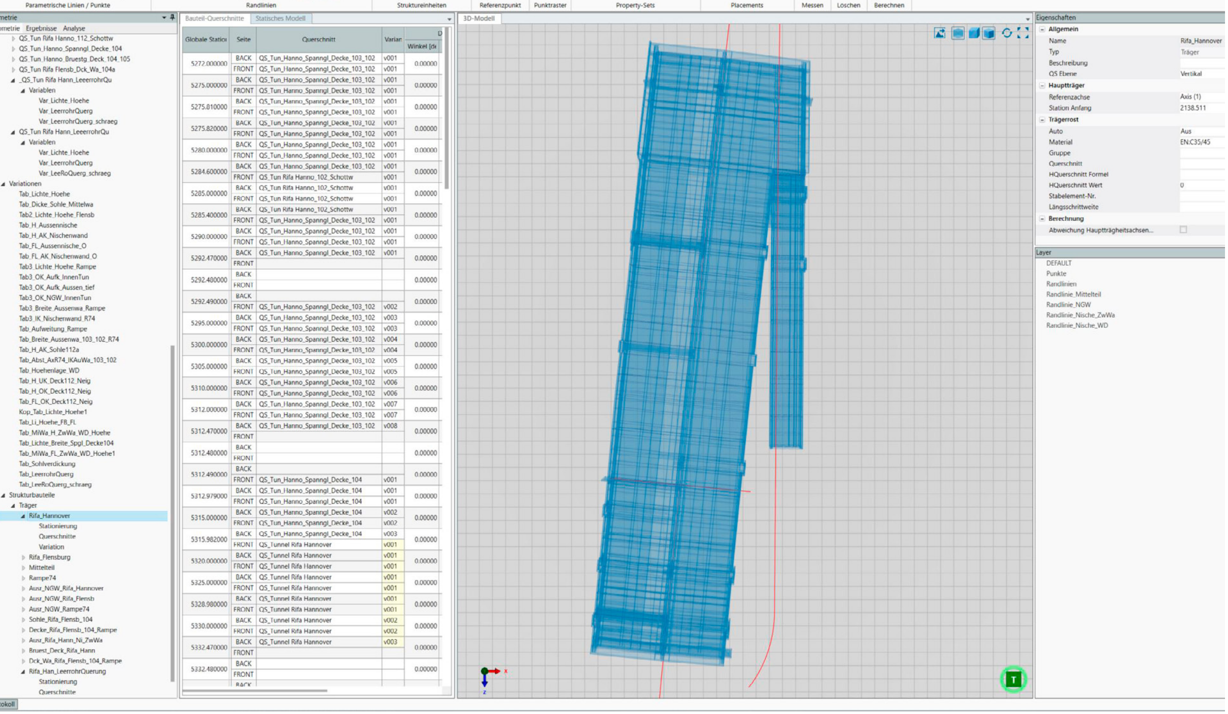
TUNNEL STRUCTURE WITH VARIATIONS

The major Altona Cover project includes extensive construction measures that are not limited to the noise protection cover alone. In addition to the construction of around 4,500 meters of retaining wall, three bridges must be demolished and replaced by new crossings in the tunnel cells. For the operational and traffic technology, traffic sign bridges must be built or rebuilt, and two operating buildings as well as 14 escape and operation staircases have to be erected. In addition to the noise protection cover, an approximately 700-meter-long noise protection wall is to be built in the northern connecting area to further reduce the impact on residents.

A special aspect to be considered in the planning is the high groundwater level in the area between the Elbe tunnel and the S-Bahn bridge. At the moment, this is still being lowered for the current operation of the highway by a well system that discharges the unused water into the Elbe. To reduce operating costs, a closed tunnel with a combined pile and slab foundation is planned here. In addition to the latter, the noise protection cover also has many other variations in the foundations; some areas are constructed as double-row large-bore piles with pile-head beams, for example. Similarly, the slabs vary, being mainly reinforced with bonded steel in cast-in-place concrete, but also prestressed or constructed with semi-precast elements supplemented by cast-in-place concrete.

PARAMETRIC MODELING OF VARYING CROSS SECTIONS

HOCHTIEF Engineering was entrusted with the execution planning for the closed section of the tunnel mentioned above. The two directional lanes – Hanover and Flensburg – are separated by a tunnel center wall. Four lanes run in each of the two tunnel tubes, together with additional turning lanes and hard shoulders. A particular planning challenge lies in accurately designing the structure, with its frequently changing cross-sections, in accordance with the BIM execution plan, while simultaneously considering the gradient and various details of the corresponding stationing (route kilometers). Due to installations at the lower edges of the slab such as light signals, traffic signs, fans, etc., the clear height of the tunnel varies. The on- and off-ramps of the highway in turn affect the tunnel width. At the same time, technical and safety installations in the walls require niches or protrusions to accommodate electrical equipment, emergency call pillars, fire hydrants, etc., as well as openings for escape doors.



In Allplan Bridge, parametrically designed cross-sections can be created georeferenced along an axis. HOCHTIEF Engineering used this for fast and precise planning of the tunnel with all variations and details. © HOCHTIEF Engineering

To be able to generate a corresponding mathematically correct 3D model with all the necessary details without considerable additional effort, the engineers decided to use parametric modeling in Allplan Bridge. With the help of the program, cross-section changes – such as slab and ramp expansions or niches in center and exterior walls – can be created along an axis using parametric cross-sections and the associated variation tables. The stationing is determined from the axis and gradient data imported into Allplan Bridge. The parametric cross-sections are calculated with all their variations along these axes and finally connected to form a 3D body. Since Allplan Bridge allows several axes and gradients to be read and assigned to the corresponding cross-sections, the different gradient curves of the carriageways could also be taken into account during modeling.

FURTHER REFINING WITH ALLPLAN ENGINEERING AND OPEN BIM

Following the parametric modeling of the tunnel in Allplan Bridge, including the invert, walls, slabs, and all niches, openings, construction joints, and block joints, the still incomplete model was further refined in Allplan AEC. In the process, further components and details were added, such as bored piles, cut-off walls made of sheet pile sections (bottom edge of the invert), anchor rails (walls and slabs), crossing empty pipes (invert), and all joint tapes and plates. The overall model of the tunnel generated in this way was then used in some cases to automatically derive the formwork plans (bored pile foundation, invert including drainage pipes, shafts, outer and middle walls, and slabs, including all built-in parts). The direct data exchange with the external planning parties – for example, with regards to the connecting tunnel blocks or the drainage pipes – was carried out using Open BIM via the IFC interface. This way, external specialists could use whichever software they preferred without losing data.

PROJECT INFORMATION AT A GLANCE

- **Focus:** Civil engineering
- **Software used:** Allplan Bridge, Allplan AEC
- **Client:** DEGES Deutsche Einheit Fernstraßenplanungs- und -bau GmbH
- **Implementation planning:** HOCHTIEF Engineering GmbH
- **Service phases:** 4 and 5
- **Start of construction:** 2021
- **Planned completion:** 2028

"Allplan Bridge is not only suitable for the creation of 3D bridges, but for all 3D roadway structures that are bound to an alignment axis. In our case, we created the tunnel cross-sections parametrically and were thus able to work out the specific features of the tunnel depending on the course of the gradient and in the corresponding stationing."

Brit Krumrey, Senior Design Engineer
HOCHTIEF Engineering

THE CUSTOMER

As an engineering office of HOCHTIEF, HOCHTIEF Engineering employs more than 500 people worldwide. With over 100 years of experience, the company offers innovative solutions for industrial, public, and private clients. The competencies that have grown together over the decades enable the engineers to provide consulting, planning, and management support for all phases of a project and thus a holistic view of the project – from the concept to the operation of a project. HOCHTIEF Engineering's core competence lies in customized structural and building services planning and consulting in the fields of transportation infrastructure, energy infrastructure, and building construction. Construction process management, project control, materials technology, and virtual design and construction (VDC) round off the range of services.

ABOUT ALLPLAN

ALLPLAN is a global provider of BIM design software for the AEC industry. True to our "Design to Build" claim, we cover the entire process from the first concept to final detailed design for the construction site and for prefabrication. Allplan users create deliverables of the highest quality and level of detail thanks to lean workflows. ALLPLAN offers powerful integrated cloud technology to support interdisciplinary collaboration on building and civil engineering projects. Around the world over 600 dedicated employees continue to write the ALLPLAN success story. Headquartered in Munich, Germany, ALLPLAN is part of the Nemetschek Group which is a pioneer for digital transformation in the construction sector.

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